

CLAIMS

1. A display apparatus, comprising:

5 a substrate on which a plurality of closed spaces are two-dimensionally disposed along a surface of said substrate,

a plurality of particles contained in each of the closed spaces, and

10 a reflection surface for reflecting light which enters each of the closed spaces,

wherein said particles are moved in each closed space, between a position at which they are diffused to cover said reflection surface and a
15 position at which they are collected to expose said reflection surface, to change an intensity of reflected light so as to provide a bright display state and a dark display state,

wherein at least a part of the reflection
20 surface diffuse-reflecting incident light with a directivity when said particles are located at the position at which the reflection surface is exposed, and

wherein a light intensity of the diffuse
25 reflection with the directivity has such an angular distribution that:

(1) an amount of reflected light toward the

position at which said particles are collected is smaller than that thereof in the case where the reflection surface is an isotropic diffuse reflection surface, and

- 5 (2) an amount of reflected light toward positions other than the position at which said particles are collected is larger than that of reflected light toward the position at which said particles are collected.

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2. A display apparatus, comprising:

a substrate on which a plurality of closed spaces are two-dimensionally disposed along a surface of said substrate,

- 15 a plurality of particles contained in each of the closed spaces,

a partition wall for dividing the closed spaces into each of the closed spaces in a direction along the surface of the substrate, and

- 20 a reflection surface for reflecting light which enters each of the closed spaces,

wherein said particles are moved in each closed space, between a position at which they are diffused to cover said reflection surface and a
25 position at which they are collected to expose said reflection surface, to change an intensity of reflected light so as to provide a bright display

state and a dark display state,

wherein at least a part of the reflection surface diffuse-reflecting incident light with a directivity when said particles are located at the position at which the reflection surface is exposed,
5 and

wherein a light intensity of the diffuse reflection with the directivity has such an angular distribution that:

- 10 (1) an amount of reflected light toward the partition wall is smaller than that thereof in the case where the reflection surface is an isotropic diffuse reflection surface, and
- (2) an amount of reflected light toward portions
15 other than the partition wall is larger than that of reflected light toward the partition wall.

3. An apparatus according to Claim 1 or 2,
wherein the reflection surface has a portion close to
20 the position at which the particles are collected or the partition wall, and the directivity at the portion is stronger than those at other portions of the reflection surface.

25 4. An apparatus according to Claim 1 or 2,
wherein the angular distribution of the intensity of light from the reflection surface is such that it is

asymmetrical with respect to a direction of a normal to the reflection surface in an area close to the position at which the particles are collected or the partition wall so as to be localized toward a
5 direction apart from the position or the partition wall and that it is substantially symmetrical with respect to the normal direction in an area other than the area close to the position or the partition wall.

10 5. An apparatus according to Claim 4, wherein the reflection surface is divided into a plurality of reflection areas different in reflection characteristic from each other, and the angular distribution of the intensity of light from each of
15 the divided reflection areas is such that it is changed stepwise or continuously from a strong level to a weak level with respect to the directivity with an increasing distance of the particles from the position at which the particles are collected or the
20 partition wall and that it is changed stepwise or continuously from a large level to a small level or no level with respect to the asymmetry with the increasing distance.

25 6. A display apparatus according to Claim 1 or 2, wherein the reflection surface is substantially a mirror surface in an area close to the position at

which the particles are collected or the partition wall, and is a diffuse reflection surface in an area other than the area close to the position or the partition wall.

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7. An apparatus according to Claim 3 or 4, wherein at least a portion of the reflection surface in an area close to the position at which the particles are collected or the partition wall is
10 inclined upward the position or the partition wall.

8. An apparatus according to Claim 1 or 2, wherein at least a portion of the substrate is transparent and the reflection surface is
15 semitransparent, and a light source is disposed below the substrate.

9. An apparatus according to Claim 1 or 2, wherein the apparatus further comprises a front
20 scattering layer disposed on an observer's side.

10. An apparatus according to Claim 1 or 2, wherein the plurality of particles are substantially black.

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11. An apparatus according to Claim 2, wherein the partition wall has a color substantially identical

to a color of the plurality of particles.

12. An apparatus according to Claim 1 or 2,
wherein in each of the closed spaces, a pair of
5 electrodes are disposed and a surface of at least one
of the electrodes constitutes at least a portion of
the reflection surface.

13. An apparatus according to Claim 1 or 2,
10 wherein in each of the closed spaces, a color filter
is disposed on the reflection surface.

14. An apparatus according to Claim 1 or 2,
wherein in each of the closed spaces, a pair of
15 electrodes are disposed and at least one of the
electrodes is transparent and disposed on the
reflection surface.

15. An apparatus according to Claim 14, wherein
20 in each of the closed spaces, a color filter is
disposed between the reflection surface and the
transparent electrode.

16. An apparatus according to Claim 1 or 2,
25 wherein the plurality of particles are electrically
charged particles and are dispersed in an insulating
liquid in each of the closed spaces.